

Development of a dual-pneumatic tourniquet for haemorrhage control in austere military environments

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Objectives

Haemorrhage associated with traumatic extremity injuries remains one of the leading causes of preventable death on the battlefield. There has been a widespread reintroduction of emergency tourniquets on the battlefield and an associated improvement in casualty survival rates. Criticism towards the use of tourniquets largely centres around the potential for tissue damage. Moreover, in the battlefield, limited resources, stressful conditions, and the complex medical trauma associated with injuries arising from explosions and gunshot wounds, can result in tourniquet misapplication which has implications for the efficacy of subsequent procedures and increases risk of death by limb exsanguination. We sought to develop a device to address these concerns.

Methods

The device first measures the patient's systolic pressure through oscillometry and then inflates to apply this pressure plus a user-defined overpressure at the first occlusion site. The pressure is maintained for a user-defined interval period, after which systolic pressure is again measured and the appropriate occlusive pressure is applied to the second site. This cyclical application of pressure crucially allows for reperfusion of downstream tissue and reduces the total occlusion time for any single site. This dual pneumatic tourniquet was tested using the Hapmed Tourniquet Trainer - an established testing platform for novel tourniquet systems, particularly within the defence sector.

Results

Results show that the dual-pneumatic tourniquet is able to quickly apply sufficient occlusive force to control haemorrhage. The magnitude of this force is tailored to the patient's systolic pressure and is applied to two separate sites in order to minimise tissue damage. The system permits short periods of downstream reperfusion as scheduled by the user to maintain tissue viability.

Discussions

We have developed a dual pneumatic tourniquet capable of managing haemorrhage control in battlefield injuries with a view to minimise tissue damage. This device has the potential to improve casualty outcomes whilst reducing the burden on military medical personnel. Further investigations are planned.

Conclusions

We present a novel tourniquet system capable of addressing concerns with current haemorrhage control practices in military applications.

Keywords: dual-pneumatic tourniquet, haemorrhage control, military environments